

CLAIMS

What is claimed is:

- 1 1. A method of producing an electrode capable of binding an analyte thereto
2 comprising:
3 providing a substrate capable of binding a dithiol molecule thereto;
4 electrochemically treating said substrate using cyclic voltammetry
5 to provide a treated substrate having a fractal dimension of greater than
6 about 2; and
7 contacting said treated substrate with dithiol molecules to produce
8 an electrode having dithiol groups attached thereto and capable of binding
9 an analyte to be detected thereto.

- 1 2. The method of claim 1 wherein said provided substrate comprises a metal
2 capable of bonding to the sulfur atom of a thiol compound.

- 1 3. The method of claim 2 wherein said metal is selected from the group
2 consisting of gold, platinum, silver, nickel, copper, stainless steel, and
3 alloys of two or more thereof.

- 1 4. The method of claim 2 wherein said metal comprises a metal selected from
2 the group consisting of gold and platinum.

- 1 5. The method of claim 2 wherein said provided substrate is selected from the
2 group consisting of metal wire and metal powder.

- 1 6. The method of claim 2 wherein said provided substrate is a coiled metal
2 wire substrate.

- 1 7. The method of claim 2 wherein said provided substrate is a wire mesh
2 substrate.

- 1 8. The method of claim 2 wherein said provided substrate comprises a non-
2 metal powder.
- 1 9. The method of claim 1 further comprising the step of contacting the
2 substrate, prior to the electrochemical treatment step, with one or more
3 fluids to prepare the surfaces thereof for electrochemical treatment.
- 1 10. The method of claim 9 wherein said contacting step comprises contacting
2 the substrate with a fluid selected from the group consisting of potassium
3 hydroxide, ammonium hydroxide, water, perchloric acid, and combinations
4 of two or more thereof.
- 1 11. The method of claim 9 wherein said contacting step comprises contacting
2 the substrate with ammonium hydroxide, then water, and then perchloric
3 acid.
- 1 12. The method of claim 1 wherein said treated substrate has a fractal
2 dimension of greater than about 2.1.
- 1 13. The method of claim 1 wherein said treated substrate has a fractal
2 dimension of greater than about 2.2.
- 1 14. The method of claim 1 further comprising the step of polarizing the treated
2 substrate before such substrate is removed from any solution in which
3 cyclic voltammetry is conducted.
- 1 15. The method of claim 14 wherein said treated substrate is polarized at a
2 voltage of about 2.0 volts for about 30 seconds.

1 16. The method of claim 1 further comprising the step of washing the treated
2 substrate with one or more fluids prior to contacting the treated substrate
3 with dithiol molecules.

1 17. The method of claim 16 wherein said washing step comprises rinsing the
2 treated substrate in a fluid, sonicating the treated substrate while immersed
3 in a fluid, or combinations of two or more thereof.

1 18. The method of claim 1 wherein said dithiol molecules are described by the
2 formula I:

$$4 \quad \text{HS}-[\text{CH}_2]_n\text{-SH} \quad (\text{I})$$

5 wherein n is from about 2 to about 10.

1 19. The method of claim 18 wherein n is from about 2 to about 8.

1 20. The method of claim 1 wherein said analyte to be detected is heme.

1 21. The method of claim 1 wherein said analyte to be detected is hemoglobin.

1 22. The method of claim 1 wherein said analyte to be detected is cytochrome c.

23. A method of accumulating an analyte from a target sample onto an electrode comprising:

providing an electrode produced according to claim 1; and

contacting said electrode with a target sample comprising an analyte capable of bonding to a dithiol moiety to bond at least a portion of said analyte to said electrode.

- 1 24. The method of claim 23 wherein said contacting step comprises positioning
2 the provided electrode in a capillary tube and passing the target sample
3 through the capillary tube to contact the electrode.
- 1 25. The method of claim 23 wherein said contacting step comprises positioning
2 the electrode in a glass tube and under a glass filter within the tube and
3 passing the target sample through the glass filter and into contact with the
4 electrode.
- 1 26. The method of claim 25 wherein said provided electrode comprises wire
2 mesh.
- 1 27. The method of claim 23 wherein said contacting step comprises bubbling
2 nitrogen through the target sample for at least a portion of the contacting
3 step.
- 1 28. The method of claim 23 wherein said analyte is heme.
- 1 29. A method of detecting an analyte comprising:
2 providing an electrode produced according to claim 1;
3 contacting said electrode with a target sample comprising an analyte
4 capable of binding to a dithiol moiety to bind at least a portion of said
5 analyte to said electrode; and
6 detecting the analyte bonded to the electrode.
- 1 30. The method of claim 29 wherein said analyte is detected using cyclic
2 voltammetry or differential pulse voltammetry.
- 1 31. The method of claim 30 wherein said analyte is detected using mass
2 spectroscopy.

- 1 32. The method of claim 30 wherein said analyte is heme.
- 1 33. The method of claim 32 wherein said target sample has a concentration of
- 2 less than about 2 nanmolar to greater than about 10 micromolar.